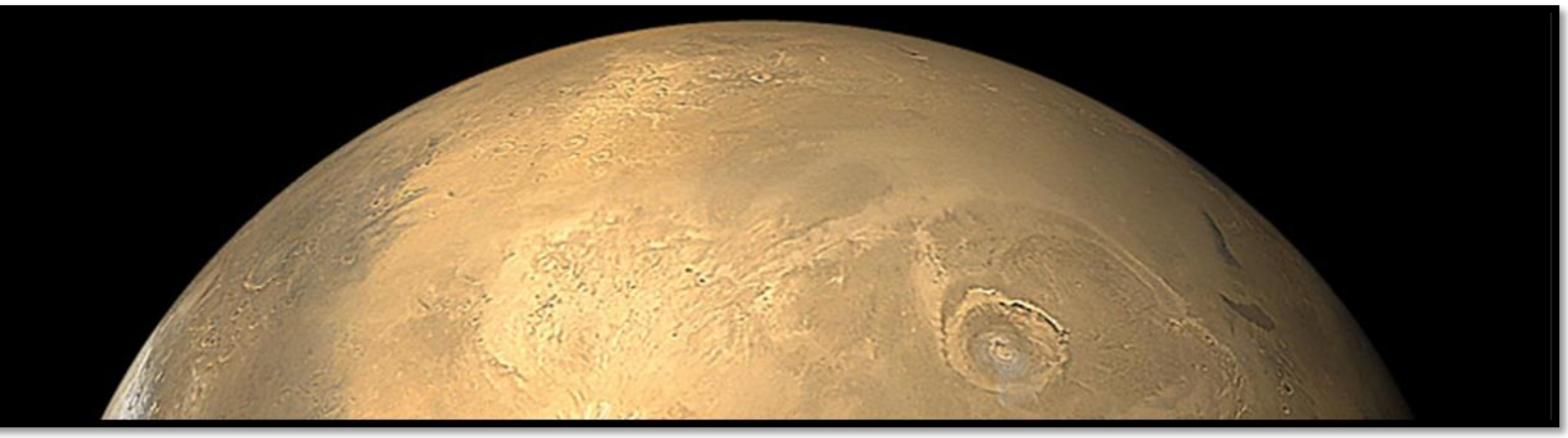

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Critical Literature Review

(ANTA602)

Antarctica and manned missions to Mars:

Antarctica as a natural field study for psychological changes in an isolated and confined environment (ICE).

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Abstract:

This review covers literature related to both Antarctic psychology and potential manned missions to Mars. By studying the effects on human health and behaviour when personnel winter-over in Antarctica, it is possible to use this data to predict the behaviours that would be seen in a long duration space flight and would allow a suitable selection process to be implemented in order to reduce the risk of serious interpersonal conflict or psychological issues. This review aims to cover (briefly) the history of psychology in Antarctica, the common effects seen as well as the patterns observed, and then use this information as a starting point to delve into the psychology of other isolated and confined (ICE) environments – namely a long duration shuttle mission to Mars. Personnel views expressed are my own and I draw conclusions about my thoughts on the future based on the reviewed literature.

Contents

Introduction:

Antarctica is an isolated and confined environment (ICE) and personnel inhabiting Antarctica experience higher exposure to extreme stressors similar to those experienced during spaceflight (Suedfeld 1987). The stability of each person involved is essential to smoothly running an operation and interactions within the group itself can also weigh heavily of the mental and behavioural health of people involved. Recent technology advances have put many countries into the race to be the first to successfully land people onto Mars. NASA (arguable the world's largest space programme) has committed to these manned flights to Mars but with this comes exploration into new and unfamiliar territory. Understanding the impact that these long distance flights may have on their personnel is important and ultimately being able to predict the success of these flights is the driving force behind a successful space mission. The data for human reactions to long term space flights is non-existent and short term flight accounts are few, this means that programmes such as NASA have been looking into other ways to gather information. Simulations and capsule environments are used, but natural laboratories are proving to be the most effective. Antarctica is most often used to simulate the Mars flight and landing experience due to the similarities in isolation and confinement as well as the uncanny geographical similarity. Data gathered so far about personnel interactions when put under stresses such as those seen in Antarctica are proving to be very useful for the evaluation of cosmonaut selections.

History and background:

Why should psychology be studied for space flight?

Since the first moon landing in 1969, popularity of space travel has radiated. The successful establishment of the international space station (ISS) in 2000 created the possibility of long

duration manned missions to the outer reaches of space. Journeys of more than 6 months are going to be more common (Sandal et al 2007, Gunderson 1974, Robinson et al 2007). Missions to mars have been predicted to be underway within the first half of this century. During the first years of space travel, journeys were shorter and made of a homogenous crews of young males of a similar nationality, but international collaboration is expected for these long term missions (Suedfeld & Weiss 2000). Interactions between people of different cultures in an isolated extended flight is vital to understand in order to maintain peace aboard the vessels as well as ensure that the mission progresses smoothly (Suedfeld & Weiss 2000 , Sandal et al 2007, Kanas et al 2009).

The European space agency (ESA) has assessed human responses and needs for such missions in the HUMEX study (Horneck et al 2006). This study relieved that 4 critical areas need to be addressed. The first is radiation health risks associated with transfer phases of travel, the second is health risks associated with zero gravity such as bone and muscle deterioration, the third is the necessity of life support systems and finally the fourth is the psychological risks from confinement in a small space. Horneck et al (2006) recommends that the best approaches to manage these is research in the ISS, robot investigations of Mars, ground simulation and analogue studies using natural environments such as Antarctica. Using Antarctica as an analogue for space travel has long be investigated by the United States NASA programme and the Soviet space programme (Sandal et al 2007, Suedfeld & Weiss 2000, McKay 1991). Antarctica not only possesses similar physical and geographic properties to Mars, but it also offers a unique field experiment arena for assessing human interactions in isolated and confined conditions (Lugg & Shepanek 1999). Soviet medical experts claim that "the main medical problem in space is psychology" and the aspects of Antarctica that cause psychological stress have been well documented. (McKay 1991) Antarctica during the winter is an ideal place to carry out these human interaction experiments as the lack of any sunlight and disturbance of circadian rhythms are similar to what is expected of space travel (Roberts 2011).

Antarctic psychology:

Antarctica is the only continent without a native human population. Current residents of Antarctica are chosen to work in a community structure that promotes harmony, peace and cooperation. The continent is often described in psychology as an ICE, an Isolated and Confined Environment, and for appropriate reasons (Sandal et al 2007, Palinkas 2003). Antarctica is the least inhabited continent and the humans that do populate it live enclosed in small bases or tents, and during winter, will almost never leave them.
Psychology in Antarctica has been extensively studied over the years and has been documented since the first expeditions to the continent (Guly 2012). Members of Scott's expeditions noted the changes in their outlook of Antarctica during and after the expeditions. Cherry-Garrard wrote that "Antarctica is the worst way to have the best time of your life" and also noted that "… socially, the polar explorer must make up his mind to be starved" while Scott himself wrote "Great God! This is an awful place" (Roberts 2011, Cherry-Garrard 2013, Scott 2004). But perhaps the most enlightening comment of psychology in the early explorations was the observation of Edgar Evans who calculated that "13% of Scott's men were mentally deranged after the expedition" (Lugg 2005). Antarctica has never been an easy place to live or explore, but wintering-over is often referenced as

the most psychologically stressful time to be there. Constant darkness, raging winds, low social interactions and the inability to venture outside can take its toll on a person.

The first group of explorers that wintered over in Antarctica were those of the 1898 *Belgica* voyage and since then, many others have done the same (Palinkas 2002). Accounts of changed behaviour and attitude over winter was first documented by Fredrick cook, the doctor aboard the *Belgica* expeditions who said "mentally, the outlook was that of a madhouse" (Roberts 2011). As of 2002, there were 44 year-round stations positioned around Antarctica. These stations vary in both number of occupants and in the facility size. For example, the United States maintains both McMurdo station (Antarctica's largest base) and the Amundsen–Scott South Pole station (arguable the most isolated). McMurdo station usually houses 200 staff and researchers over the winter period while the South Pole station houses only 50 (Palinkas 2002). These varying degrees of station size as well as the diversity of the people in them allows for an ideal setting for investigating the basic human psyche in low stimulus conditions.
It is therefore vital that any personnel that are staying over winter do not possess any preformed psychological problems in order to minimise risk. During the IGY (International geophysical year) Smith experimented with methods of selecting for personnel but the first fully funded psychological analysis was conducted by the International Biomedical Expedition to the Antarctic (IBEA) who collected data from base staff and researchers in the field (Gunderson 1974, Suedfeld & Weiss 2000, Smith 1961) . Now, psychological studies on personnel are commonplace and staff have to pass a rigorous test in order to be cleared for winter-over duty.

These studies are becoming more important in reference to human space travel. Space travel shares many traits with wintering-over in Antarctica such as darkness, lack of communication and reduced social interactions (Suedfeld & Weiss 2000, Sandal et al 2007, Roberts 2011) With Manned missions to mars in the near future, space programmes such as NASA and the Soviet Space programme have invested into research for potential problems that astronauts may have as well as how to choose the most appropriate personnel to minimise these problems.

Psychological effects of wintering-over:

Patterns and symptoms:

The 'winter-over syndrome' was identified by Strange and Youngman in 1971. This syndrome is categorised by seasonal mood shifts associated with the lack of daylight, and can be effected and made more severe by external stressors such as deprivation of social stimulation, loss of security, absence of social status, inability to escape small confines, and the lack of privacy (Palinkas 2002, Strange & Youngman 1971). Winter over syndrome is the commonplace name given to symptoms expressed due to the experience of a shift during winter in Antarctica. These symptoms disappear after the winter period is over and daylight and normal rhythms are reintroduced (Palinkas & Houseal 2000). Most winter-over staff exhibit mild to moderate psychological difficulties associated with winter service. The most commonly reported symptoms are listed below:
Insomnia, depression, irritability, anxiety, impaired cognition, aggression, social withdrawal, hygiene neglect, the 'Antarctic stare' (a fugue-like state), aches and pains, headaches, lack

of interest, concentration difficulties (Décamps & Rosnet 2005, Zuniga 1962, Taylor & Brown 1994, Stokolos 1976, Palinkas 1987, Suedfeld & Weiss 2000, Sandal et al 2007, Palinkas 2002, Kanas et al 2009., Guenter et al 1970, Reed et al 1986, McKay 1991, Gunderson 1973)

The 'third quarter phenomenon' is a time period during the winter stay and is defined as "an increase in negative mood and social interactions… as personnel contemplate the duration of time remaining before the end of their particular [Antarctic] experience" (Bechtel and berning 1991, Sandal et al 2007, Steel 2001) This period is when most behavioural and emotional problems are reported by wintering staff (Palinkas & Houseal 2000). There are commonly four stages exhibited throughout this phenomenon, of which the third stage (Third quarter) has the most psychological change. Stage 1 "The alarm stage" is where the thought process of deciding to winter-over is questioned. Stage 2 "The resistance stage" where disputes and competitions are engaged in in order to boost self-esteem and protect against being excluded. Stage three "The exhaustion stage" where helplessness is felt over the inability to change the current situation, and finally, Stage four, seen shortly before the wintering period ends, where feelings of happiness and uncertainty arise prior to the return home (Décamps & Rosnet 2005). Stage three, with the feelings of helplessness and exhaustion in where symptoms such as depression kick in. The vulnerability of people during this time also allows other symptoms to appear. During this time, there is also an increase in rebellion and troublesome behaviours. There have been incidents of assaults, harassment and breaching discipline as personnel try to break the monotony of day to day life in the base (Suedfeld & Weiss 2000)

Polar T3 syndrome is also commonplace among wintering staff. This syndrome affects the thyroid function and the cold causes similar symptoms to hyperthyroidism. This causes rapid changes in mood and reduces memory. This is often seen in cyclic pattern similar to the seasons (Roberts 2011).

Reducing the risk:

Overall, the rate of psychiatric disorders in Antarctica sits at around 5% (cent (Lugg, 2005, Roberts 2011). This rate is no higher than that of any given population. What makes this a high number, and a cause for concern, is that these people have all been previously tested and screened for any likelihood of disorders. 3% of the US Navy personnel posted in Antarctica showed similar psychiatric problems compared to the 1% seen in the Navy outside Antarctica.

There are many things that can affect the success of a group in Antarctica. Main categories have been proposed by Palinkas (1987) these are, Objective and goals, Philosophy's and values, cultural composition of personnel, organisation, technology, the social environment, and physical environment and finally the length of personnel duty (Palinkas 1987).

Research has identified that interpersonal conflict is the largest stressor of problems in Antarctica (Stuster et al 2000, Sandal et al 2007). Because of this, identification of potential conflicts before wintering –over begins is essential. Previously collected data from mood scales and interviews of staff provide insight into the working of a confined group environment. A psychological assessment has been administered for all participants on all Operation Deep Freeze (American) trips since the early 1960s (Palinkas 1987). Differences

between cultures and status of station members are also carefully monitored as effectiveness to adjust has been linked with the participant's education and occupation backgrounds. The three most commonly used screening tests are 1) clinical evaluations, 2) attitude tests and 3) biographic information (Gunderson 1974).

In the American bases, conflict between personnel usually occurred between military and civilians. It has been shown that those who cope the best are those that have a higher social or economic status in the outside world (Palinkas 1987). Introverts are preferred as personnel for wintering-over. Extroverts struggle with the lack of social networks and isolation from support back home. Introverts on the other hand, adapt quickly to the isolation and autonomy of this duty. People who lack conscientiousness and attention from others also make ideal candidates.

Contrary to most research, some have found no evidence of psychological change or psychiatric symptoms. (Leon et al 1989). There has been four possibilities put forward to explain this. First, ICE's are not more stressful than other environments (Suedfield & steel 2000), Second that personnel that volunteer for these tasks are capable of maintaining stable performance, Third is that these motivated individuals actually perform much better than others, and finally, that these reaction are more strongly affected by the interactions and cultural influences than any other stressors (Sandal et al 2007).

Fortunately, it is not all doom and gloom. A long term study carried out by Palinkas (1992) showed that wintering-over had long term benefits to people's health. Reports indicate that these people establish bonds with the other people who shared their experience, as well as a bind to Antarctica itself. Post wintering, people have reported being more confident, happier, more caring and more mature. Although there has been a few reports on positive psychological change (Steel 2005, Suedfeld and Steel 2000, Palinkas 2002, Roberts 2011) proportionally, positive outcomes of the winter-over experience have barely been researched. Interest lies mostly with the potential of understanding the negative effects and how to prevent them.

The future:

Mission to Mars:

In the likely event that a manned mission to Mars occurs, these psychological assessments and the data recorded would be vital to understanding the human reactions to such environments. Since the data from long term space missions does not exist yet, analogue studies (such as Antarctica, Submarines and capsules) must be used instead (Manzey 2004, Norris et al 2010). Both the US and the Soviet have gathered research from previous space missions, but this data is limited and may be irrelevant to the longer duration trips that will induce a lot more stress on the participants. NASA has frequently shunned the possibility of having psychological problems aboard its missions, unlike Russia who openly admit it may become a problem (Suedfeld & Weiss 2000, Gunderson & Palinkas 1998). Although reports show that the possibility of psychological and behavioural problems is low, the implications of such an event on a space mission would be critical and could endanger the success of the mission as well as the lives of all those aboard (Lugg 2005).

Using Antarctica to assess Mars missions is possibly the best analogue study possible. Both environments require participants to be in a small enclosed shelter, have specially designed clothing and equipment, have minimal communication with the outside world and their loved ones, are in a remote location, may have problems dealing with emergencies, injuries or breakdowns, and both groups have had their social atmosphere selected for. (Suedfeld and Steel 2000). In space, there are more associated stressors that cannot be accounted for by using Earth field or simulation studies. These are the excessive microgravity, and the 'Earth-out-of-view' phenomenon. This last one has been speculated as being more serious, as travellers on the way to mars will be the first people ever to see their home planet shrink away (Kanas et al 2009, Sandal 2001).

Cultural, sexual or racial differences have anecdotally been the cause of the most psychological breakdowns aboard space missions. For example Kanas et al (2009) states that "during one Salyut mission, a visiting cosmonaut from Czechoslovakia felt socially isolated and complained of being restricted from doing productive work by his Russian crewmates who were concerned that this foreign guest might inadvertently make an operational error" (Kanas et al 2009). This is important to note as cultural differences and disagreements in values can cause a riff between party members and endanger the success of the mission and the lies of all those aboard.

Gaps in the knowledge about the psychological effects of manned space missions still exist, but knowledge is slowly growing. With NASA's recent move to focus on psychology, this shows that they too do admit that this could become a potential issue aboard these long term flights. Fortunately there is a rigorous selection process for crew for most of these missions, but it is my personnel belief that there could never be enough. All grounds should be covered in order to reduce the risk as much as possible. In order to prevent syndromes developing, crews should be assessed together as the past research shows that the interactions among the group are often the most influential. I think future research should focus on these interactions as well as the individual. Cultural and social attitudes can make a big difference to how well a mission will run and how good personnel will feel afterwards. Cultural diversity should not be shunned but instead it should be ensured that no two values or beliefs of people contradict each other as this may be a starting point for interpersonal conflict to arise.

A man on Mars used to seem like a faraway dream, but with missions expected in the next twenty years, human exploration is about to reach a new peak. It is exciting to think that the human race could be on a new planet in such a short amount of time, and it is thrilling to know that somewhere as special as Antarctica could be making such as big difference to the potential success of these missions.

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